

## Diving into the World of Sound and Light, Understanding Their Properties, Propagation and Uses

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### ABSTRACT

The aim of this research is to introduce students to the basic concepts of sound and light during science learning. This abstract discusses the properties of sound, such as its source, propagation, and how the human ear receives sound. Apart from that, this abstract also discusses light as an energy source that allows us to see objects around us, including how the eye propagates and receives light. Once students understand these concepts, it is hoped that they will be able to understand between sound and light. Sound waves can modulate the amplitude and phase of light, bending it, focusing it, or shifting its frequency. Light can create visible acoustic images or provide detailed information about thermal vibrations in solids and liquids. Diffraction of light waves by sound waves takes several different forms, depending on the two wavelengths and the dimensions of the interaction region. Sound waves can modulate the amplitude and phase of light, bending it, focusing it, or shifting its frequency. Light can create visible acoustic images or provide detailed information about thermal vibrations in solids and liquids. Diffraction of light waves by sound waves has several different forms, depending on the two wavelengths and the dimensions of the interaction area. Sound is a wave produced by a vibrating object. Meanwhile, light is energy that has electromagnetic waves and can propagate in a vacuum. Sound can travel through solids, liquids and gases.

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## INTRODUCTION

Natural Sciences (Science) is an important lesson for students at elementary school (SD) level. Science is a way of finding out about nature systematically to master knowledge, facts, concepts, principles, discovery processes and scientific attitudes (Depdiknas, 2006). The essence of science learning is to develop students' understanding of nature, develop the skills needed to acquire or develop new knowledge, and develop positive attitudes in students.

Sound and light are both forms of energy that travel in the form of waves. Although they differ in many ways, including their nature and propagation, they both play a very important role in our lives. Sound is a mechanical wave that requires a medium (such as air, water, or solid) to propagate, while light is an electromagnetic wave that can propagate even through a vacuum. Additionally, they have different characteristics in terms of speed, frequency, wavelength, and other properties that make them unique in their interactions with the surrounding environment.

## METHOD

This research aims to analyze and describe students' understanding of sound and light. This type of research is qualitative research. The data used in this research is secondary data obtained from various sources, such as books, journals and scientific articles. The research steps are as follows:

1. A literature review was carried out to study the meaning, properties, propagation of sound and light.
2. Data obtained from the literature review was analyzed using statistical analysis to obtain conclusions.

Data and Data Analysis the data used in this research is secondary data obtained from various sources, such as books, journals and scientific articles.

## RESULTS AND DISCUSSION

Humans are creatures who have various senses, one of which is the sense of hearing. In human life, what is most often encountered is sound. Sound is often used to communicate or as a medium for information. Have you ever felt confused about why when you speak in the open air, your voice can be heard far away and screams in a vacuum echo. When you are on a mountain, the voices of the people become loud and can be heard up to the top of the mountain and when you shout, for example in a cave, your voice will bounce and echo. This will happen because of a characteristic possessed by sound waves.

According to (Anissa, 2020) Sound waves are waves that propagate through a certain medium. Sound waves are mechanical waves which are classified as longitudinal waves. According to (Habiburrohman et al., 2021) Sound waves are produced due to vibrations that are propagated in the medium through interactions between the molecules that make it up. These waves have characteristics such as amplitude, frequency and wavelength. So these sound waves can transmit sound to the human ear. Therefore, sound/sound occurs as a result of vibrations that are transmitted to the listener's ears.

### Understanding Sound

Sound is the most important sound element. According to (Kustaman, 2017) Basically, sound-conducting media can have various properties and shapes, they can be solid, liquid and gas, depending on the extent to which the properties of the object can transmit sound through the air. The properties of sound can be measured through the laws of physics, for example frequency is a unit of speed of sound which is measured in vibration units called Hertz (Hz), while sound loudness or amplitude is measured in decibels (dB). The number of vibrations that occur in each second. The greater the vibration amplitude of an object, the louder the sound produced. The faster the vibration frequency of an object, the higher the pitch of the sound produced. It really depends on the type of object vibrating, one of which is music. Sound comes from a sound source, which is vibrated by force or energy, such as the membrane on a musical instrument and the lips on a wind instrument. Then the vibrations are delivered or emitted by the conductor. And when these vibrations reach our ears, then we can hear them. The definition of sound is a longitudinal wave resulting from a vibration that can stimulate the human sense of hearing. That sound travels like water waves was first suggested by Marcus Vitruvius Polio in Rome, a century before Christ. The quantitative theory of sound was first put forward by Sir Isaac Newton. The intensity of sound waves that humans can hear is an average of 10-12 watts/m<sup>2</sup>, called the hearing threshold. Meanwhile, the greatest intensity of sound that can still be heard by humans without causing pain is 1 watt / m<sup>2</sup>, called the threshold of feeling.

Sound Propagation All forms of sound originate from vibrating objects. Vibrations from an object will cause the air around it to vibrate. These vibrations create sound waves in the air. Objects that vibrate and produce sound are called sound sources. And so on, so that sound energy can propagate from one place to another. Sound can travel through solids, liquids and gases. The following is the propagation of sound, namely:

- 1) Sound travels through solid objects.

The speed of sound propagation for each object is always different. Sound propagates through solid objects faster than through liquid or gas objects. For example, stick your ear to the wall! Ask your friends to hit other parts of the wall! A hitting sound will be heard. This shows that sound travels through solid objects. The sound of hitting the wall sounded louder through the wall.

2) Sound travels through liquid objects.

Sound propagation through water. When we hit two stones in water, the sound can be heard from outside the water. This shows that sound travels through water. The impact sound is weaker than the sound of a rock impacting outside the water. This shows that sound propagation through water is less good than through air.

3) Sound travels through gaseous objects.

One of the gaseous objects is air. Sound can travel through the air, such as the sound of thunder that we often hear when it rains. When thunder occurs, the air pressure changes, namely going up and down. This change in pressure continues to move through the collision of small pieces of air molecules. Thus, sound waves propagate in all directions and can be heard from various directions. Another example, when a bell is struck, we hear the sound. This shows that sound travels through the air.

However, sound cannot propagate in a vacuum. Sound can only be heard at frequencies between 20 and 20,000 Hz, which are called audio frequencies or human hearing frequencies. Below 20 Hz frequencies are called infrasonic frequencies. Above 20,000 Hz is called ultrasonic. Frequency is the number of vibrations that occur every second, and the unit of frequency is Hertz (Hz). According to (Suwantin, 2023) Based on frequency, sound is divided into three types:

1. Infrasonic

Sounds that have very low frequencies of <20Hz. Infrasonic waves were discovered in 1960 by a French scientist named Vladimir Gavreau who was born in Russia. This sound is too low to be accepted by human hearing. This infrasonic can travel long distances and can propagate without any obstacles and without reducing its frequency significantly. Even though it cannot be detected or heard by the human ear, some animals can hear or perceive this infrasonic sound. Such as: Elephants, hippos, dogs, pigeons, spiders, crickets.

2. Audiosonics

Audiosonics have frequencies in the 20Hz-20KHz range. This sound can be captured or heard by human hearing. However, human hearing sensitivity will decrease as we age. Human ears have been created to hear these waves since birth into the world. It's just that brain awareness factors influence the propagation of the sound.

3. Ultrasonic

This type of wave has the highest frequency in terms of decibels, namely waves that are above 20,000 Hz. These waves cannot be heard by humans because the decibel (dB) pressure level is very high, these waves propagate through solids, gases and liquids. The level of reflectivity of these waves is the same in solid and liquid media, only if the surface is covered with foam and other fibrous materials, these waves will be absorbed. Ultrasonic waves are used by humans for navigation purposes, for example sonar is used to measure the depth of the seabed through sound propagation which is then reflected back to the surface. In other human lives, ultrasonic waves are widely used as a tool in medical science, for example, ultrasound (ultrasonography) tools are used to see internal human organs such as the liver, tumors, heart and so on.

As for According (Nurhayati, 2018) The properties of sound are divided into 2, namely:

1. Sound can be absorbed

is that if there is an object with a soft surface, an object called a sound absorber will appear. There are also several soft surfaces that can dampen sound, including: paper, foam, sponges,

carpets, go-karts, and wool. If you use these objects, sound reflections or echoes can be avoided.

2. Sound can be reflected

As has been explained, sound reflection occurs due to sound vibrations hitting a hard surface. The hard surface of an object does not absorb sound but rather reflects it, so we can hear the sound of the reflected sound. There are two types of reflected sound that we need to know, namely reverberation and reverberation.

a. Echo

Echo is a reflected sound that we believe is almost the same as the original sound. Because the timing is more or less the same, the echo makes the original sound less clear due to interference or collisions from the reflected sound.

b. Echo

Echo is a reflected sound that is heard after the original sound. The distance is not close, meaning the reflected sound appears after the original sound ends. Echoes can occur if the sound source and the reflecting wall are far from each other.

Sound has many uses in everyday life, including:

1. Sound is used to communicate, both orally and in writing.
2. Sound is used for entertainment, such as listening to music, watching movies, and playing games.
3. Sounds are used to provide warnings, such as ambulance sirens, fire department sirens, and car horns.
4. Sound is used to measure distance, depth, and speed.

### Understanding Light

According to the Big Indonesian Dictionary (KBBI), light is light or light that comes from something that shines such as the sun, moon and lamps. Scientifically, light is energy in the form of electromagnetic waves with a wavelength of around 380-750 nm. Electromagnetic waves are waves consisting of an electric field and a magnetic field that are perpendicular to each other and propagate simultaneously. According to (Son, 2022) Light is an example of an electromagnetic wave, and light waves do not require a medium as a medium for propagation. for example, even though the sun is far from the earth, sunlight still shines on the earth so that it appears brighter during the day. Even though the sun is far from the earth and separated by empty space in space, the sun is far from the earth and shines on the earth. However, physical light can reach the earth. There are many objects around us that emit Light. Objects that can emit light are called light sources. There are two types of light sources: natural light sources and artificial light sources. 1) Natural light, Wiyanto (2021) states that light that comes from the sun is a celestial body that can emit light in large and continuous quantities. According to Ridwan (2021) Sunlight has various benefits ranging from household needs such as drying in the sun, to the use of alternative energy, namely electrical energy sources. By using the use of the sun, we can increase the growth of sophisticated technology in the industrial and household worlds, therefore electrical energy really supports human activities every day, so that with this alternative energy the need for electrical energy will be met. 2) Artificial Light, acc Faujiah (2022) Artificial light is one of the needs for light according to the needs of human activities, for example in a room, such as lamps. Light is electromagnetic radiation that can be seen by the human eye. Objects that emit light are now called light sources (Velrahga, 2021). According to Istidah (2022) Light has several properties, including:

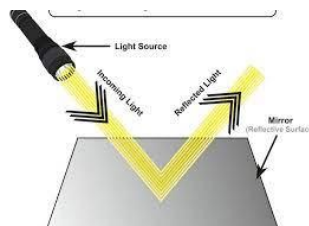
1. Light travels straight



**Figure 1.1** Straight propagating light

Straight propagation will occur if it passes through an intermediate medium. A simple example is when you turn the flashlight forward, the light will travel straight in the desired direction. To prove that light travels in a straight line, it can be seen from sunlight entering through gaps or through the windows of our house. And if the lights are on a motorized vehicle at night, the light from the motorized vehicle's lights travels in a straight line. There are many events that occur in life that can prove that light has the property of being able to travel in a straight line.

## 2. Light Can Be Reflected



**Figure 1.2** Light can be reflected

Reflected light is the process of light being re-emitted from the surface of an object exposed to light. The nature of this reflection is divided into two, namely regular reflection and diffuse reflection. When light hits a flat, smooth and shiny surface, the reflection results will be regular. Meanwhile, when light hits an uneven, rough and bumpy surface, the reflection results will be diffuse. Reflection of light can provide benefits to humans. An example is that humans can see their reflection in a mirror.

In regular reflection the reflected light rays are parallel. For example, when we play during the day carrying a mirror. If you point the mirror in the direction of the sun's rays, then try to point it in all directions, there will be a reflection of light reflected from the sun's rays.

## 3. Light Can Pass Through Clear Objects



**Figure 1.3** Light can penetrate clear objects

Clear objects are objects that can be penetrated by light. This is because clear objects are able to transmit light. Like clear glass that can be penetrated by light, this event can prove the nature of light that can penetrate clear objects. But if light hits a dark object, the light will not penetrate but will form a shadow. Also with clear glass, sunlight can still enter the room, even though there are obstacles because the windows are made of clear glass. An example is when we look at a window with clear glass, light will still come in.

## 4. Light Can Be Refracted



**Figure 1.4** Light can be refracted

Refraction is the event of a bend in the direction of propagation of light when it passes through a different propagation medium. Refraction is the process of bending the direction of propagation of light when it passes through two media of different densities. This refraction of light by humans is utilized in various optical devices. For example, when we swim and put a stick into the water exposed to sunlight. When viewed from above, the stick will look larger than its original size. pencil inserted into water in a glass.

#### 5. Light Can Decompose



**Figure 1.5** Light Can Decompose

Light decomposition or light dispersion occurs naturally. An example is when a rainbow occurs. The colors in the rainbow come from just one color, namely the white color of the sun. However, the white color is refracted by raindrops, resulting in the white light being broken down into several colors so that beautiful colors are formed. In a narrow area, light experiences wave bending, namely the occurrence or events of bending the direction of propagation of light waves because they pass through a narrow gap. or is the decomposition of white light into light that has various colors. This event is proof that light can be described.

Light has many uses for human life, including:

1. To see, light is needed to stimulate the photoreceptor cells in the eye so that we can see.
2. For communication, light is used to transmit communication signals, such as in traffic light signals and radio signals.
3. Light is used to create interesting visual effects, such as in musical performances and films.

### CONCLUSION

Sound and light are two natural phenomena that are important in everyday life. Sound is a vibration that propagates through a medium, while light is an electromagnetic wave that propagates through a vacuum. These two phenomena have many uses in human life. Sound is the most important sound element. According to (Kustaman, 2017), basically sound-conducting media can have various properties and shapes, they can be solid, liquid and gas, depending on the extent to which the properties of the material can transmit sound through the air. The properties of sound can be measured through the laws of physics, for example frequency is a unit of speed of sound which is measured in vibration units called Hertz (Hz), while sound loudness or amplitude is measured in decibels (dB). According to (Suwantin, 2023) Based on frequency, sound is divided into three types: Infrasound; Audiosonics; Ultrasonic. According to the Big Indonesian Dictionary (KBBI), light is light or light that comes from something that shines such as the sun, moon and lamps. Scientifically, light is energy in the form of electromagnetic waves with a wavelength of around 380-750 nm.

Electromagnetic waves are waves consisting of an electric field and a magnetic field that are perpendicular to each other and propagate simultaneously. Based on the source, light is divided into two, namely natural light and artificial light. 1) Natural light is (Wiyanto, 2021) states that light comes from the sun, which is a celestial body that can emit light in large and continuous quantities. According to (Ridwan et al., 2021) sunlight has various benefits starting from household needs. 2) Artificial Light, accFaujiah (2022) Artificial light is one of the needs for light according to the needs of human activities, for example in a room, such as lamps. According to Istdidah (2022) Light has several properties, including: Light travels straight; Light Can Be Reflected; Light Can Pass Through Clear Objects; Light Can Be Refracted; Light can undergo decomposition.

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